RHONDDA URBAN DISTRICT COUNCIL.

SPECIAL REPORT

UPON

AN EPIDEMIC OF TYPHOID FEVER

WHICH OCCURRED IN THE

RHONDDA URBAN DISTRICT

IN

1904-5,

BY

THE MEDICAL OFFICER OF HEALTH.

TREHERBERT:
I. JONES, PRINTER, ETC., STATIONERS' HALL.

Digitized by the Internet Archive
in 2018 with funding from
Wellcome Library

https://archive.org/details/b30481715

GENERAL INFORMATION.

The Rhondda Urban District is 23,885 acres in extent and is wholly situated in the northern part of the County of Glamorgan. It consists in the main of two narrow tortuous valleys, joined together at their lower extremities but separated from each other and skirted by steep hills which rise at their highest point to an elevation closely approaching 2,000 feet above ordnance datum. The whole of the district is well within the range of the South Wales coalfield, the coal strata being overlain by or alternating with thick beds of Pennant Sandstone Small areas of peat overlying clay are not uncommon throughout the district. The prosperity of the neighbourhood is almost entirely dependent upon its coal, a great deal of which is of the kind known as smokeless steam coal, and is much prized for its relatively high steam-raising quality, and for the comparative absence of smoke ~~to which~~ associated with its combustion, ~~gives rise~~. The rainfall pertaining to the district is generally unusually heavy but subject to wide variations in different years ; the average annual fall for the last 5 years at Treherbert at an elevation of 801 feet reached 85 inches, and the average for the same period at a point of 590 feet above ordnance datum and within the area of the epidemic was 68 inches.

Although the population was only 55,632 in 1881, the subsequent increase has been so rapid that the population in 1891 amounted to 88,351, and in 1901 to 113,735 persons, and is estimated to have increased to 122,310 by the end of June 1904. In 1901 (last census year) out of a total of 42,657 engaged males above 10 years of age, no fewer than 32,625 were "coal and shale-miners."

The general death-rate of the Rhondda Urban District has been relatively high, the average rate for the last 10 years being 20·14 per 1,000 persons living, whereas the mean rate for England and Wales was only 17·2 per 1,000 living during the same decade. The mortality-rate from typhoid fever in the Rhondda for the same period was slightly more than twice that for England and Wales, the respective figures being ·32 and ·15 per 1,000 living. That for the Rhondda has ranged from ·18 in 1902 to ·50 per 1,000 in 1899. The district has been many times visited by more or less serious though localized epidemics of typhoid fever, which have been generally attributed to contamination of one of the many water supplies which are to be found throughout the district. One notable exception was the epidemic, consisting of 169 cases with 27 deaths, which occurred in the first half of the year 1903. The circumstances associated with the occurrence and spread of that outbreak tended to the belief that milk was the vehicle which served to convey the essential cause of the disease to so many persons.

The rateable value of the Rhondda Urban District is £527,210, and the general district rate for the year 1904-5 is three shillings in the pound.

SANITARY ADMINISTRATION.

The sanitary staff under the Council consists of a Medical Officer of Health, who devotes the whole of his time to the duties pertaining to the office, six sanitary inspectors, each of whom is allotted an approximate sixth of the district, two clerks, and three men engaged in the conveyance and disinfection of clothing. The district is possessed of a recently-built isolation hospital with accommodation for 32 beds, arranged in two blocks of equal size. On the same site is situated the Council's old isolation hospital with space for 4 beds.

SEWERAGE AND DRAINAGE.

In 1885 a Joint Sewerage Board, consisting of 14 members, 5 elected by the Pontypridd and 9 by the Rhondda Authorities, was appointed for the purpose of taking steps to lay a joint outfall sewer from the lower end of the Rhondda district through Pontypridd to a point on the coast 4 miles east of Cardiff. The work was begun in 1889 and completed in 1892 at a cost of £156,000. The total length of the sewer is 17½ miles. In 1894 the work of laying down 2 main sewers for the Rhondda—one sewer for each valley—was brought to a successful termination at a cost of £60,000. Ever since that year long sections of subsidiary sewers have been annually constructed, in order to enable the connection of house drains throughout the district to be effected. During the last 10 years a capital sum of £43,200 has thus been spent. The separate system of drainage is adhered to where practicable surface water except that falling on roofs (in part) and back yards being conducted by a separate system of drains direct into the river or its tributaries. The subsidiary sewers, being of recent construction and of stoneware pipes, are on the whole in very good condition throughout the district. Owing to the effect of subsidence caused by the colliery workings, much trouble and expense are occasioned by the relative change of level in certain sections. The effect of such occurences is generally to render it impossible for the subsided section to clear itself satisfactorily, and the house drains discharging into the particular length of sewer may and not infrequently do, after heavy rain, serve as channels of relief for the sewage, the back yards and even the houses themselves being on such occasions apt to be flooded with the contents of the sewer. No systematic flushing is practised ; in winter the rainfall is so heavy that there is usually no need to supplement the cleansing thus caused ; in summer there is such a constant dread of the occurrence of a scarcity of water in the district that under ordinary circumstances none is spared for the flushing of sewers Much work has been done in the direction of effecting the connection to the sewer of the unconnected houses in the district ; during the last seven years 3,786 houses have been so dealt with, there still remaining 504 unconnected houses at the end of the year 1904. A considerable number of the remainder are possessed of a proper system of drains, which however empty into surface water drains or a neighbouring brook owing to the absence of a sewer within statutory distance. Another isolated group of 50 houses is now being provided with pail closets in substitution for the existing ash-middens. There are exceedingly few cesspools throughout the district, the construction of only one having been sanctioned by the Council within recent years. Moreover many of the unconnected houses such as farm-houses are far removed from other habitations, while many others are arranged in small and isolated groups ; in both these instances it is highly propable that the houses will always remain unconnected to the sewer. Sewer ventilation is secured by means of open gratings fixed in connection with manholes on a level with the roadway. In a few situations where gratings have proved exceptionally objectionable on account of their position, shafts have been erected and carried up above the eaves of the nearest houses. In the case of some of the older property, built when the insertion of disconnecting traps was not strictly enforced, the ventilating shafts in connection with the house drains doubtless serve for the ventilation of the sewers to a considerable extent. Only a very small proportion of the houses in the district possess internal offices such as water closets, so that the influence upon the public health of gaseous emanations from sewers and drains which may be defectively ventilated cannot be of the importance which is claimed for them in towns differently circumstanced in this respect. It is estimated that 30 to 35 per cent. of the total number of closets in the whole district are hand-flushed, and the ascertained proportion of the hand-flushed closets in the typhoid infected houses amounted to 35.5 per cent. of the total.

WATER SUPPLY.

In connection with a description of the water supplies, the Rhondda Urban District may be divided into two portions. One portion extends from the upper end of the larger valley to a boundary line dividing into two parts, Penygraig on the west side and Trealaw on the east side of the river. The portion thus defined constitutes the water area of the Council, and is wholly situated in Rhondda Fawr (Large Valley). The remainder of the district, including the whole of the lesser valley as well as the larger valley below the lower boundary of the Council's area, is in the main supplied by the Pontypridd Water Co. Within each of these two areas there are smaller areas possessing independent supplies, the more extensive and numerous being situated in the district supplied by the Council. The whole of the area supplied by the Council has an ~~average~~ acreage of 15,182 acres, with an estimated number of 11,427 houses, and a population of 67,647 persons. To arrive at the number of houses actually supplied by the Council, about 1,000 deriving their supply from the independent sources already mentioned must be excluded. The average daily consumption per head in 1904 amounted to 15·36 gallons for domestic purposes, the additional quantity required for trade purposes not exceeding one gallon per head. At present the total storage capacity of the Council's reservoirs is only 7,000,000 gallons. Practically all the water is upland surface water, and is filtered by means of sand. During the last Parliamentary Session the Council obtained an extension of time in which to carry out a scheme whereby an additional storage capacity of 167,000,000 gallons will be obtained, the intention being to acquire and utilize a natural lake (Llyn Fawr) for the purpose. The Pontypridd Water Company have a storage capacity of 200,000,000 gallons, and the method of filtration practised is partly by means of sand filter-beds, but mainly by means of the patent filters known as Reeve's, in which the filtering medium is quartz or polarite. In addition to the main gathering ground at the head of the larger valley, the Council have another much smaller collecting area six or seven miles lower down the same valley and on the hillside about midway between the river Rhondda and the watershed on the east side of that river. The water derived from this source is passed through one of two sand filter-beds and thence to a service tank of 40,000 gallons capacity. This is known as the Tyntyla Water Supply, and will be further alluded to in connection with the circumstances pertaining to the epidemic.

HISTORY OF EPIDEMIC.

The first intimation of anything unusual was received on Tuesday, the 8th day of November, 1904, on which day two notifications of typhoid fever came to hand from Ystrad. Later on the same day oral information was received by Sanitary Inspector J. Towy Thomas from Dr. E. L. Phillips of several more cases suspected to be suffering from the same disease. The Medical Officer of Health and Inspector Thomas immediately made inquiries, and the facts elicited at first pointed to the implication of a certain milk supply. A list of all the houses regularly obtaining their milk from the suspected supply was obtained, but further investigation at each of the houses served, led to a weakening of the suspicion which, earlier in the day, rested on that particular milk supply. At a later hour, on the same day, the Medical Officer of Health, in proceeding to keep an appointment, was informed that there were several cases of an illness resembling influenza in Trealaw, the district immediately adjoining Ystrad. It was considered not improbable that the disease would prove to be typhoid fever in its initial stages, and that there might be a causal connection between the two series of cases, the one at Trealaw and the other at Ystrad. On the morning of the 9th the receipt of 12 more notifications of typhoid fever, limited in point of locality to the lower end of Ystrad and the upper end of Trealaw, still further weakened the evidence which, on the previous day, justified the pointed investigation already mentioned as having been made in connection with a certain milk supply. The distribution of the cases aroused the suspicion that an occasionally used water supply may have been instrumental in propagating the disease. The Medical Officer of Health consequently interviewed Mr. Octavius Thomas, the Council's Water Manager, on the morning of Wednesday the 9th, or the day following that on which the two first notifications were received. The additional information gleaned at the interview served to strengthen the suspicion that the water supply referred to had a causal connection with the epidemic. Consequently measures were at once taken to cease distributing the suspected water to the consumers, and no more water for the supply of any portion of the district was drawn from the suspected source after the 9th of November. The means of distribution available enabled the Manager to thus cut off the suspected supply without serious inconvenience to the consumers. On the same day the possession of sterilized bottles enabled the Medical Officer of Health to take, for bacteriological examination, a sample of the suspected water from a settling tank at the works, as well as two samples of the sediment deposited by the water in certain tanks on its course to the filter beds. The three samples were immediately despatched per Mr. E. R. Jenkins (senior clerk in the Health Department) to the County Laboratory, an explanatory note of the circumstances being at the same time sent with the samples. On November the 11th, the acquisition of more sterilized bottles afforded an opportunity to take a sample of water from the dead end of a water main near the Gas Works, which are situated at a low level within the infected area. The water on the filter beds had in the meantime been allowed to drain away, and by means of a sterilized spoon portions of the surface film from 12 points on the beds were taken on the same day, and were, as in the case of the samples taken on the 9th, sent by special messenger to the County Laboratory. On Friday, the 11th of November, the Council appointed a small Committee, with full powers to take any steps that might be considered necessary to successfully cope with the outbreak. The number of cases notified steadily and rapidly increased, so that by November the 30th an aggregate of 322 had been reached. The highest total for any one day was attained on the 15th, or one week from the commencement of the epidemic, on which day ~~69~~ 71 notifications were received. On and after the 20th of November a marked fall was noticeable in the daily number of cases notified, but it was not until December the 6th that a blank day was recorded.

As soon as it was realised that the epidemic was likely to become a serious one, the Committee appointed by the Council, under the Chairmanship of Mr. Rhys S. Griffiths, took active measures with the view of checking the spread of the disease and of relieving those who had already been stricken down. At an early stage Dr. J. Pugh Jones was appointed to attend upon the patients at the isolation hospital. The situation of the hospital in the midst of the infected area rendered it possible to remove many patients thereto in the course of a day, so that by the evening of Friday the 11th the institution contained 61 patients, of whom 38 suffered from typhoid fever. The old hospital was, as expeditiously as possible, got ready for the reception of those patients suffering from typhoid fever who were already in the hospital and in a convalescent stage, more accommodation for those in the acute stages of the disease

TABLE 1.—Showing daily number of Typhoid Fever Notifications received.

1904.		*Within the epidemic area.*		*Rest of the Urban District.*		Remarks
		Total Cases	Number from houses not already implicated	Total Cases	Number from houses not already implicated	
Nov.	1	—	—	—	—	
,,	2	—	—	1	1	
,,	3	—	—	—	—	
,,	4	—	—	—	—	
,,	5	—	—	—	—	
,,	6	—	—	—	—	
,,	7	—	—	—	—	
,,	8	2	2	—	—	1st day of epidemic
,,	9	12	12	—	—	Water cut off
,,	10	4	4	—	—	
,,	11	39	37	1	1	
,,	12	39	31	1	1	
,,	13	15	12	2	2	
,,	14	16	12	—	—	
,,	15	71	45	1	1	
,,	16	13	11	—	—	
,,	17	29	24	1	1	
,,	18	15	11	—	—	
,,	19	15	13	—	—	
,,	20	8	4	—	—	
,,	21	7	4	—	—	
,,	22	9	7	—	—	
,,	23	8	5	3	3	
,,	24	4	2	1	1	
,,	25	2	1	1	1	
,,	26	2	2	1	1	
,,	27	5	3	—	—	Disinfection of Water Mains
,,	28	4	2	—	—	” ” ”
,,	29	3	2	—	—	” ” ”
,,	30	3	2	—	—	
Dec.	1	4	1	—	—	
,,	2	1	—	—	—	
,,	3	1	1	1	1	
,,	4	3	1	—	—	
,,	5	2	1	—	—	
,,	6	—	—	2	2	
,,	7	1	—	—	—	
,,	8	—	—	—	—	
,,	9	—	—	—	—	
,,	10	2	1	—	—	
,,	11	—	—	—	—	
,,	12	1	—	—	—	
,,	13	1	—	—	—	
,,	14	—	—	—	—	

TABLE I (Continued).

1904.	*Within the epidemic area.* Total Cases	*Within the epidemic area.* Number from houses not already implicated	*Rest of the Urban District.* Total Cases	*Rest of the Urban District.* Number from houses not already implicated
Dec. 15	—	—	—	—
,, 16	—	—	—	—
,, 17	—	—	1	1
,, 18	—	—	—	—
,, 19	2	1	—	—
,, 20	1	1	1	1
,, 21	—	—	—	—
,, 22	—	—	—	—
,, 23	—	—	—	—
,, 24	—	—	—	—
,, 25	—	—	—	—
,, 26	—	—	—	—
,, 27	4	2	1	1
,, 28	1	1	—	—
,, 29	—	—	—	—
,, 30	—	—	—	—
,, 31	—	—	—	—
1905.				
Jan. 1	—	—	—	—
,, 2	—	—	—	—
,, 3	—	—	—	—
,, 4	4	1	—	—
,, 5	2	1	—	—
,, 6	—	—	—	—
,, 7	—	—	—	—
,, 8	—	—	—	—
,, 9	—	—	—	—
,, 10	1	1	—	—
,, 11	—	—	—	—
,, 12	1	1	—	—
,, 13	—	—	—	—
,, 14	—	—	2	1
,, 15	—	—	—	—
,, 16	—	—	—	—
,, 17	1	1	—	—
,, 18	—	—	1	—
,, 19	—	—	—	—
,, 20	1	—	1	—
,, 21	—	—	—	—
,, 22	—	—	—	—
,, 23	—	—	—	—
,, 24	1	—	—	—
,, 25	—	—	—	—
,, 26	—	—	—	—
,, 27	1	—	—	—
,, 28	—	—	—	—

Table 1. (Continued).

1905	*Within the epidemic area.* Total Cases	*Within the epidemic area.* Number of houses not already implicated	*Rest of the Urban District.* Total Cases	*Rest of the Urban District.* Number from houses not already implicated
Jan. 29	—	—	—	—
,, 30	1	1	—	—
,, 31	3	1	1	1
Feb. 1	1	—	—	—
,, 2	2	—	—	—
,, 3	—	—	—	—
,, 4	—	—	—	—
,, 5	—	—	—	—
,, 6	2	1	—	—
,, 7	—	—	1	—
,, 8	2	—	—	—
,, 9	—	—	—	—
,, 10	1	1	1	1
	373	267	26	22

TABLE 2.—Showing the number of Typhoid Fever Notifications received weekly from within the Rhondda Urban District.

	Week ended	Total Cases	Number from houses not already implicated	Remarks
1904	November 14	131	114	Epidemic commenced on November 8th
	,, 21	160	114	Suspected water turned off on 9th.
	,, 28	40	28	Disinfection of water mains Nov. 27—29
	December 5	18	9	
	,, 12	6	3	
	,, 19	4	2	
	,, 26	2	2	
1905	January 2	6	4	
	,, 9	6	2	
	,, 16	4	3	
	,, 23	4	1	
	,, 30	3	1	
	February 6	9	3	
	,, 10	5	2	
	Totals	398	288	

being thus obtained at the newer and more conveniently equipped institution. As soon as the diphtheria patients could be discharged without undue risk, the diphtheria pavilion was emptied, disinfected, and cleaned, so that all those portions of the hospital designed for the accommodation of patients were thrown open to the victims of the prevailing fever. Additional beds, bedding, and other necessaries were ordered, so that it was rendered possible to utilize all the available space at the institution. Although the hospital is designed to accommodate only 36 beds, it was, during the period covered by the epidemic, constantly occupied by over 50 patients. The hospital staff was augmented to meet the increased need; additional nurses were engaged, some devoting their services to the patients at the hospital, while others acted as district nurses under the superintendence of the Medical Officer of Health. Each district nurse was given a prescribed area, and, working in conjunction with the medical practitioners and sanitary inspectors, visited and nursed at their own homes those patients who were most in need of their attention, and who could not be removed to the hospital owing to want of sufficient accommodation. This step being somewhat of a new departure in the district was at first viewed with a certain amount of misgiving, but it was attended by most happy results, the nurses being warmly welcomed by doctors and patients alike. The nurses after completing each day's work met the Medical Officer of Health at the Hospital for the purpose of furnishing the latter with information as to the patients whose condition or whose circumstances rendered their removal to the hospital most desirable. The services of an additional sanitary inspector were secured for the purpose of rendering assistance to Inspectors J. T. Thomas and James Williams, in whose districts the implicated area is situated. For a period during the height of the epidemic it was also necessary to supplement their exertions by those of some of the other inspectors. The usual steps pertaining to inspection and to disinfection of houses and clothing were unremittingly carried out. At the termination of each illness, or after a patient's removal to the hospital, all the articles of clothing, bedding, &c , considered to be infected were removed in special vans to the hospital, where they were subjected to the action of steam in an "Equifex" Steam Disinfector. The rooms occupied by the patients were disinfected by means of formaldehyde gas. In the case of those patients who were treated at home, their friends were provided by the inspectors with disinfectants, chiefly in the form of perchloride of mercury tablets, with full information as to their object and the manner in which they were to be used. Within a few days of the commencement of the epidemic printed bills were distributed from house to house in the implicated area, the message conveyed thereby being to the effect that no one should drink unboiled water or milk during the prevalence of typhoid fever. Moreover, each inspector on his first visit to a newly-infected house delivered to the householder or other person in charge a leaflet briefly setting out the manner in which typhoid fever is usually conveyed from person to person, and indicating the precautions which should be taken to prevent such an occurrence. Mr. W. J. Jones, the Council's Surveyor, undertook to thoroughly flush all the sewers throughout the epidemic area, and some members of his staff were daily engaged in carrying out this work.

DISINFECTION OF WATER MAINS.

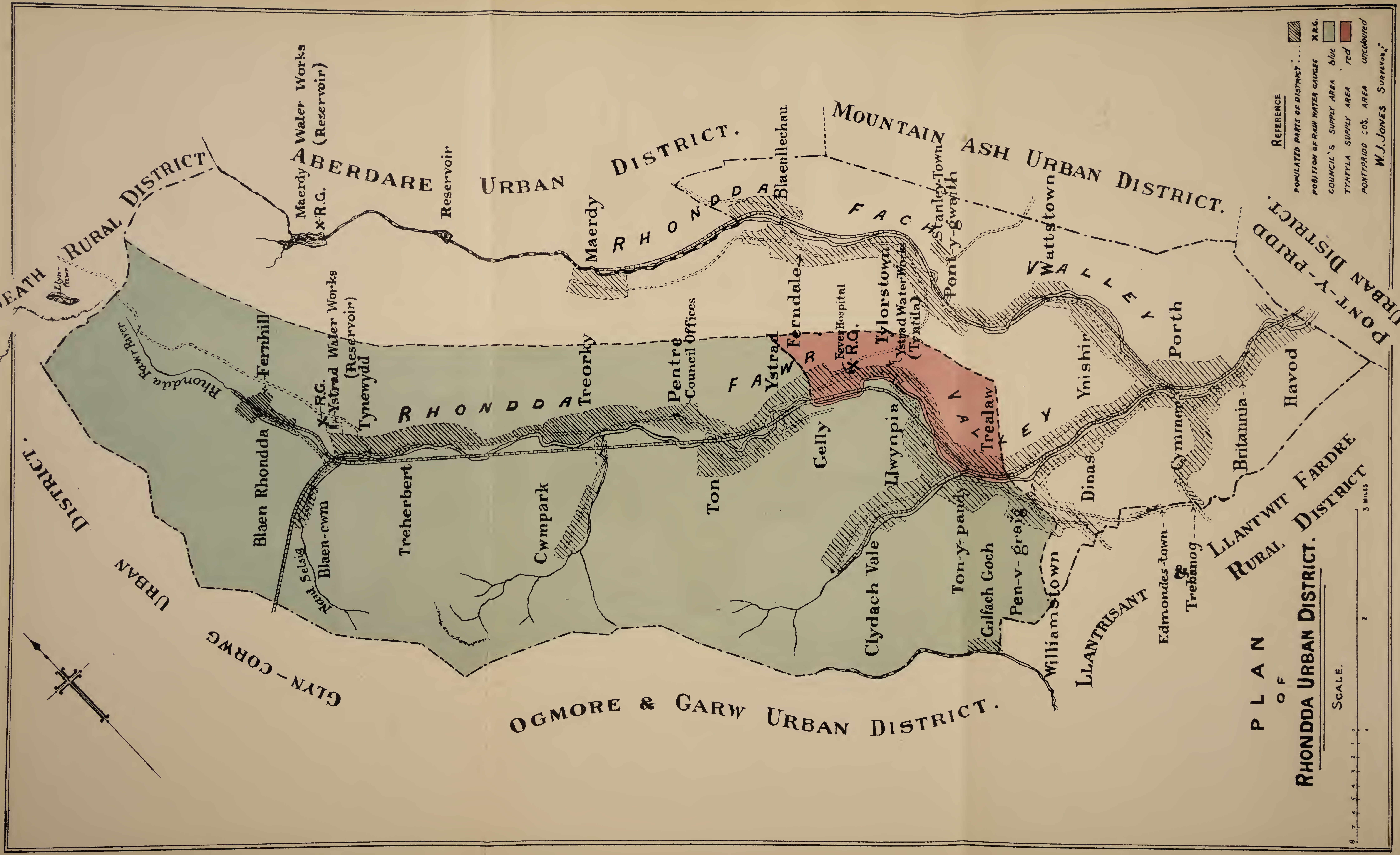
Although the existing arrangements rendered it practicable to supply the area involved with water from the Council's main waterworks at the head of the valley, they did not enable Mr. Octavius Thomas to do so without utilizing the same distributing system. Immediately, therefore, after turning off the water from the suspected gathering ground on the 9th of

November, steps were taken to thoroughly flush and reflush, again and again, the distributing mains throughout the infected district. The permission of the Council was sought and obtained to employ some means of disinfecting the water mains and service pipes throughout the area involved. It was therefore decided to more or less closely follow the method adopted at Maidstone in 1897. For this purpose two tons of chlorinated lime, guaranteed to contain 35 per cent. of chlorine, were procured at a cost of £8 per ton. A 40-gallon cistern was taken and divided into two unequal portions by a board 6 inches deep. Into the larger portion water was conducted by means of a hose, and from the smaller division led a 2-in. iron pipe, the other end of which was provided with many branches, and emptied into one of the cleaned out filter beds at the Tyntyla Works. The 40-gallon cistern was placed in the open air just outside the building which contained the filter beds. The chloride of lime was shovelled from the sacks in which it was received into the larger division of the cistern, and together with the water was subjected to constant stirring with a wooden pole. The wooden partition served to prevent the portions of the lime not disintegrated by the mixing from passing into and blocking the iron pipe. Still further stirring of the mixture was effected in the filter bed by means of long wooden poles, to allow the passage of which several holes had been made in the walls surrounding the filter-beds. The chlorine solution thus formed was permitted to gravitate into the covered-in service tank. The two tons of chlorinated lime were treated with 43,000 gallons of water, a mixture being thus obtained which was estimated to contain 1·04 per cent. of chlorinated lime: if it be accepted that the lime was of the guaranteed strength of 35 per cent. of effective chlorine, a solution of that gas of the theoretical strength of ·36 per cent. should have been available. Friday the 25th and Saturday the 26th were spent in getting ready the necessary amount of chlorine solution. On Sunday the 27th the actual disinfection was begun, the epidemic area being divided for that purpose into two portions, which were successively dealt with in the same manner. At 9 a.m. the water was turned off from the mains, which were then emptied before the disinfectant was admitted. Within one and a half hours it was ascertained by means of the flush valves and fire hydrants that the disinfectant had reached the ends of the mains. A gang of men was then set to work to visit each house, and to draw from each tap enough water to allow the disinfectant in the mains to fill the whole of each service pipe. This work was completed within two and a half hours of the time the water was first turned off. The whole of the system was then allowed to remain charged with the chlorine solution for four hours. During this time water drawn from any house tap was yellowish in colour and smelt strongly of chlorine. Two samples were taken—one from the service tank and the other from a house tap on the main road—and on being analysed at the County Laboratory were found to contain ·53 and ·55 per cent. respectively of available chlorine. The effect of one of these samples on a 24-hours broth culture of the typhoid bacillus after three hours contact was ascertained, and it was found that all solutions up to one-fifth the original strength of chlorine solution were capable of destroying vigorous typhoid bacilli in three hours. The mains were finally emptied of disinfectant, filled with ordinary water and flushed, the flushing being repeated several times before the water was considered free from objection. A sample of the water was taken at noon on Monday the 28th, and was found to be entirely free from any traces of chlorine. The total quantity of disinfectant used was 21,000 gallons During the time occupied by the disinfection of the mains, the water consumers within the area disinfected were supplied with drinking water by means of thoroughly cleansed watering carts; and in the course of the previous week there had been carried out a house-to-house distribution of circulars drawing attention to the Council's intention to turn off the water at a certain hour on the following Sunday, and to the means it was proposed to adopt to supply the consumers with water for domestic use during the time to be taken by the process of disinfection. The successful performance of the plan adopted was mainly due to Mr. Octavius Thomas, the Water Manager, who had given much time and care to the minutest detail.

It was considered probable that the extent of the epidemic would be instrumental in causing much poverty, and the district nurses and inspectors were, in consequence, instructed to supply the Medical Officer of Health with a list of those whom they considered to be suffering from the want of the necessaries of life. A fund for the purpose of relieving necessitous cases was started by Mr. W. P. Nicholas, Clerk to the Council, and was distributed as occasion arose by the members of the Sanitary Staff. Various religious bodies and private individuals also bore their share in assisting those in whom they were specially interested. On the whole, however, it was a matter for surprise that so few cases calling for assistance came to the knowledge of those who interested themselves in their relief.

CAUSE OF EPIDEMIC.

One of the most striking features in connection with the epidemic was its limitation to a comparatively small portion of the Rhondda Urban District. From November the 1st. 1904, to February 10th, 1905, there were notified throughout the whole of the Urban District 399 cases of typhoid fever; of this number 373 notifications, or 93·4 per cent., were received from an area which constitutes about one twenty-sixth of the whole district in extent, and one sixteenth in population. Within this area there are contained 1,320 houses, of which 267 or 20·2 per cent. became infected with one or more cases of typhoid fever, whereas of the 19,441 houses in the rest of the district, only 22 or ·11 per cent. were attacked.



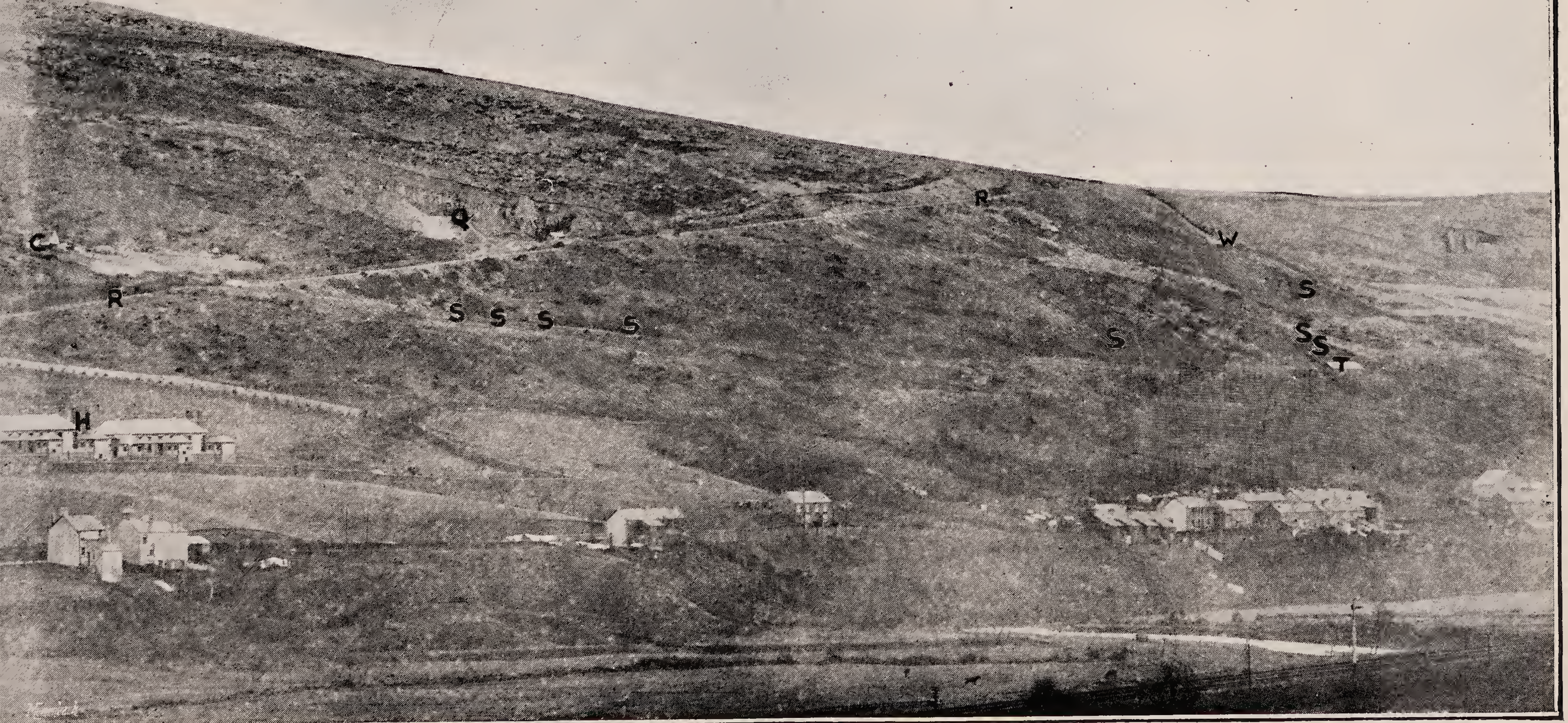
I. JONES, PRINTER, TREHERBERT.

If instead of the incidence upon houses the incidence upon persons be taken, the contrast is equally marked. The population within the area of the epidemic was ascertained by actual enumeration to be 7,605 persons, of whom 373 or 4·9 per cent. were attacked, whereas only 26 or ·02 per cent. of the estimated 115,090 persons in the rest of the district contracted typhoid fever during the same period.

Table 3.—Showing the incidence of Typhoid Fever within and without the area of Epidemic.

	AREA OF EPIDEMIC.			REST OF DISTRICT.		
	Total.	Number attacked.	Per Cent.	Total.	Number attacked.	Per Cent.
Houses ...	1,320	267	20·2	19,441	22	·11
Persons ...	7,605	373	4·9	115,090	26	·02

In general conformation, in class of people and of property, in sewerage and drainage, and in most other circumstances except the character of its water supply, the area affected differs in no important particular from the remainder of the Rhondda Urban District. It is just over two miles long and about half a mile wide, the total area amounting to 880 acres, and it comprises the lower end of Ystrad together with the upper end of Trealaw. Its northern boundary is formed by the Lamb Brook and its southern limit by Victoria Street, Trealaw; on its west side it is bounded by the River Rhondda. and on the east side by the Cefn Rhondda Watershed between the Rhondda Fawr and Rhondda Fach Valleys. On the accompanying map the area is shown in red. This portion of the district differed from the remainder at the time immediately preceding the epidemic in one important respect, for its water supply was in part derived from a different source, the gathering ground and works pertaining thereto being contained within the area as above defined. These waterworks consist of two filter beds, each being 17 feet square, the total filtering area being 570 square feet. Both the filter-beds are contained within a substantial stone building with slate roof. Between the two filter beds there is a series of small pits or settling tanks, separated from each other by metal screens, which serve to retain any coarse material suspended in the water, in the latter's passage through the series of tanks to the filter-beds. After filtration the water gravitates to a service tank of a capacity of 48,000 gallons ; the tank is underground and is constructed of stone rendered in cement, and the roof is covered by about two feet of grass-grown soil. Both filter-beds and tank are surrounded and protected by a wooden paling. The gathering ground, immediately adjacent to the works, is about 18 acres in extent, and consists in the main of rough pasture land (see photograph.) In one or two situations there is a small copse of wood, and here and there some swampy ground. On its upper or east side it is bounded throughout its length by the only main road connecting the two valleys, and immediately on the far side of the same road there is a stone quarry which was at the time being worked. The water may be collected at a series of eight small brick-lined catch-pits from each of which leads an iron pipe to join the main which discharges itself into the first of the settling tanks between the filter-beds. At the time of the epidemic only four of the eight catch-pits were in use, the other four having been discarded because the use of the water collected thereat was considered to be attended by too much risk. Most of the catch-pits were fed from springs but there is reason for believing that after heavy rain some



Tyntyla Gathering Ground, Filter-beds and Tank.

S	Springs and Catchpits.
T	Tanks and Filter-beds.
C	Cottage.
Q	Quarry.
R	Public Road.
W	St. Mary's Well.
H	Isolation Hospital.

amount of surface water derived from the road found its way into one or two of the catch-pits. Immediately beyond the southern boundary of the gathering area is a small stone building, built to protect Saint Mary's Well, the water from which was supposed, in the not very distant past, to possess healing properties whether used externally or internally. For some years however, the well has been closed to the public, but the overflow from it is accessible, and some of the water after heavy rainfall percolates through the bank which forms the southern boundary of the Tyntyla gathering ground into a streamlet on which one of the catch-pits is placed. Although there is no recognized footpath across the gathering area, the ground is not difficult of access and more than once human excrement was seen not far from some of the catch-pits. On November the 14th a sample of such a deposit was taken by Dr. William Williams, County Medical Officer of Health, and Dr. H. A. Schölberg, the County Bacteriologist, for the purpose of subjecting it to bacteriological examination. The average daily quantity of of water derived from the whole of the Tyntyla gathering ground, and utilized for the supply of the implicated area amounted to 44,000 gallons, which were supplemented by an additional quantity of 24,000 gallons from the Council's main-supply, the service tank being connected for that purpose by means of a small feed pipe with a ten-inch main which passes through this portion of the district to supply other areas. The Council supplies its district as a whole by means of two distributing mains, one ten inches, and the other six inches in diameter. With the exception of certain premises to be afterwards specified, the whole of the area involved in the epidemic is supplied by means of the smaller main which exhausts itself at the lower end of that area. On the six-inch main as it enters the area is placed a valve by means of which this section can be cut off from the main supply. At the time of the epidemic the whole of the water derivable from the Tyntyla gathering ground, supplemented by the quantity drawn from the ten-inch main, was used to serve the portion of the six-inch main which lies within the affected area. The times when the two filter-beds were scraped were given by the Manager, as the end of July in the one case, and the 28th of September, 1904, in the other case. The average rate of filtration per square foot of filter-bed amounted to 3·2 gallons per hour.

Of the 373 persons mentioned as having been attacked in houses situated within the Tyntyla area of supply, there were 6 who resided in houses which did not receive their water from the Tyntyla Works. There were in addition 15 persons who contracted typhoid fever during this period, but who, although dwelling when notified altogether outside the Tyntyla area, were more or less closely associated with that district; the majority of the 15 either lived or worked in the implicated area up to the time when the initial symptoms of the disease showed themselves, and the remainder frequently visited the district either for the purpose of exchanging social courtesies, or, in the case of a few, of giving assistance in nursing at infected houses. There remain to be allotted to the whole of the rest of the district only 11 cases which inquiry failed to associate with the general epidemic. It may be added that this number is well below the average for a similar period at the time of year covered by the outbreak.

There is still to be considered more in detail the incidence of the disease upon houses which, although situated within the Tyntyla area of supply, did not receive their water from that source. (See Table 3a.) Throughout this area there were at the time of the epidemic 103 such houses, which may further be classified into those receiving their water from the Council's main waterworks at Treherbert, and to those which were supplied with water from private sources. (See Map p. 32) Among the former group is the Isolation Hospital, not one of whose staff contracted the disease; among the latter group are the Llwynypia Union Homes, which obtain their water from some springs within their own grounds. At the time the enumeration was made, the Homes were occupied by 120 persons, of whom 4 were under 25, 39 between 25 and 65, and 77 above 65 years of age. There was not a single notification of typhoid fever received from the Homes throughout the period now under consideration. Of the remaining 101 houses, only 3 became infected. One of the 3 was an isolated farm-house, three of whose inmates contracted the disease. It was ascertained on inquiry that the attacked persons frequently visited houses which were on Tyntyla water, and that they had relations in infected houses. In the case of another of the three houses, two children were attacked; here also investigation served to prove that the attacked children not infrequently spent hours at a relation's house which obtained its water from the Tyntyla Works. With regard to the third infected house, the attacked person was, prior to his illness, a frequent visitor at a friend's house which was on Tyntyla water, and at which a fatal case occurred.

Table 3a.—Contrasting the incidence of Typhoid Fever within the epidemic area on houses and persons,—

A—on Tyntyla Water.
B—not on Tyntyla Water.

	A			B		
	Total	Number attacked	Per cent	Total	Number attacked	Per cent
Houses	1,217	264	21·6	103	3	2·9
Persons	6,921	367	5·3	684	6	·87

TABLE 4.—Showing the Age—and Sex—incidence of Typhoid Fever upon persons residing within the area of epidemic and receiving water from Tyntyla Works.

	MALES.						FEMALES.						TOTALS.					
AGES	Under 5 years	5 to 15 years	15 to 25 years	25 to 65 years	65 years and upwards	TOTAL	Under 5 years	5 to 15 years	15 to 25 years	25 to 65 years	65 years and upwards	TOTAL	Under 5 years	5 to 15 years	15 to 25 years	25 to 65 years	65 years and upwards	TOTAL
Persons ...	601	801	738	1,611	62	3,813	573	770	526	1,166	73	3,108	1,174	1,571	1,264	2,777	135	6,921
No. attacked...	19	73	57	77	1	227	14	67	22	37	—	140	33	140	79	114	1	367
Percentage ...	3·1	9·1	7·7	4·7	1·6	5·9	2·4	8·7	4·1	3·1	—	4·5	2·8	8·9	6·2	4·1	·74	5·3

INCIDENCE OF THE DISEASE IN RELATION TO POPULATION, AGE, AND SEX.

Towards the end of the outbreak, a census was taken throughout the area of the epidemic, as already defined. For the purpose of ascertaining the incidence upon those who dwelt in houses receiving their water from the suspected source, and who presumably drank more or less of the suspected water, it is necessary to exclude from consideration all those 21 cases domiciled in houses on other water supplies. As may be seen by reference to tables 4 and 3a, the total number of the consumers of the Tyntyla water amounted to 6,921, living in 1,217 houses, the average number per house thus being 5·68 persons. Males preponderated to the extent of 705, the respective numbers for males and females being 3,813 and 3,108 ; 227 or 5·9 per cent. of the former, and 140 or 4·5 per cent. of the latter, contracted the disease, the proportion of those attacked to the whole population amounting to 5·3 per cent. For both sexes the incidence was heaviest upon persons between 5 and 15 years of age, the following decennial period (15 to 25) also suffering to an almost equal extent. The old, and, to a less extent, the very young appear from the figures to have been the least susceptible. It may be, however, that influences other than mere difference in age were at work, and it is not improbable that the comparative immunity enjoyed by the very young and very old may, to some extent at least, have been dependent more upon differences in the habits and mode of life of the people at the respective ages than upon a less liability to contract the disease under given conditions. The view may be advanced that the heavy incidence of the disease upon those between 5 and 25 years of age is due to the fact that this time of life is the period of greatest physical activity, with the consequent desire for more fluid to replace the increased quantity excreted through the lungs and skin. At this age period also it is probable that less discrimination in the choice of fluid is exercised than at a later age. The same considerations may help to explain the apparently greater susceptibility of men as compared with women of the same age.

TABLE 5.—Shewing case-mortality for the whole Epidemic in relation to Age and Sex.

Ages.	MALES.						FEMALES.						TOTALS.					
	Under 5 years	5 to 15 years	15 to 25 years	25 to 65 years	65 years and upwards	TOTAL	Under 5 years	5 to 15 years	15 to 25 years	25 to 65 years	65 years and upwards	TOTAL	Under 5 years	5 to 15 years	15 to 25 years	25 to 65 years	65 years and upwards	TOTAL
Cases ...	20	74	60	79	1	234	17	70	27	40	—	154	37	144	87	119	1	388
Deaths ..	1	4	6	10	—	21	1	3	—	1	—	5	2	7	6	11	—	26
Percentage of Deaths to cases	5·0	5·4	10 0	12 6	—	9·0	5·9	4·2	—	2·5	—	3·2	5·4	4·8	6·9	9·2	—	6·7

TABLE 6.—Showing case-mortality in relation to Age and Sex for all cases which occurred in houses supplied from Tyntyla Works.

Ages	MALES.						FEMALES.						TOTALS.					
	Under 5 years	5 to 15 years	15 to 25 years	25 to 65 years	65 years and upwards	Total	Under 5 years	5 to 15 years	15 to 25 years	25 to 65 years	65 years and upwards	Total	Under 5 years	5 to 15 years	15 to 25 years	25 to 65 years	65 years and upwards	Total
Cases ...	19	73	57	77	1	227	14	67	22	37	—	140	33	140	79	114	1	367
Deaths ...	1	4	6	10	—	21	1	3	—	1	—	5	2	7	6	11	—	26
Percentage of Deaths to Cases	5·2	5·4	10·5	13·0	—	9·2	7·1	4·4	—	2·7	—	3·5	6·0	5·0	7·6	9·6	—	7·0

CASE-MORTALITY (FATALITY) IN RELATION TO AGE AND SEX.

For the period intervening between the 8th of November, 1904, and February 10th, 1905, it was concluded that 388 cases of typhoid fever notified within the Rhondda Urban District were due, directly or indirectly, to one common cause. Of this number 26 or 6·7 per cent. proved fatal ; the number of fatalities among the 234 males amounted to 21 or 9·0 per cent., whereas among the 154 females only 5 or 3·2 per cent. ended unfavourably. In regard to the influence of age upon the issue, the least unfavourable period for both sexes together, as well as for males, was that between 25 and 65 years, while in the case of females the percentage fatality was highest in those under 5 years af age (Tables 5 and 6). The total number of cases pertaining to the epidemic which were removed to the fever hospital amounted to 79 or 20·3 per cent. of the number notified. The male sex contributed 50, and the female sex 29 patients. The mortality per cent. amounted to 11·3 for all cases removed, the fatality among the males being somewhat higher than that among the females (Table 7). The results thus compare unfavourably with those relating to the whole epidemic, the fatality among those treated at home amounting to only 5·5 per cent. In this connection however it may be explained that with the exception of a few at the very beginning of the outbreak, the cases removed to the hospital were selected for removal on account of the difficulty or danger attending their treatment at home owing to the existence of some specially unfavourable symptom, such as diarrhæa or hæmorrhage, or the supervention of some dangerous complication requiring extra care or skill in nursing. The average duration of the time spent in the hospital by each of the recovered cases was 64 days, the extremes ranging from 18 to 173 days. In the case of those that ended unfavourably the average length of time intervening between the date of

TABLE 7.—Showing case-mortality in relation to Age and Sex of all cases removed to the Isolation Hospital.

	MALES.						FEMALES.						TOTALS					
AGES.	Under 5 years	5 to 15 years	15 to 25 years	25 to 65 years	65 years and upwards	TOTAL	Under 5 years	5 to 15 years	15 to 25 years	25 to 65 years	65 years and upwards	TOTAL	Under 5 years	5 to 15 years	15 to 25 years	25 to 65 years	65 years and upwards	TOTALS
Cases ...	3	11	17	19	—	50	1	13	6	9	—	29	4	24	23	28	—	79
Deaths ...	1	2	2	1	—	6	—	3	—	—	—	3	1	5	2	1	—	9
Percentage of Deaths in Cases	33·3	18·1	11·1	5·2	—	12	—	23·1	—	—	—	10·3	25·0	20·7	8·7	3·5	—	11·3

admission and day of death amounted to 12 days, the limits varying from 3 to 23 days.

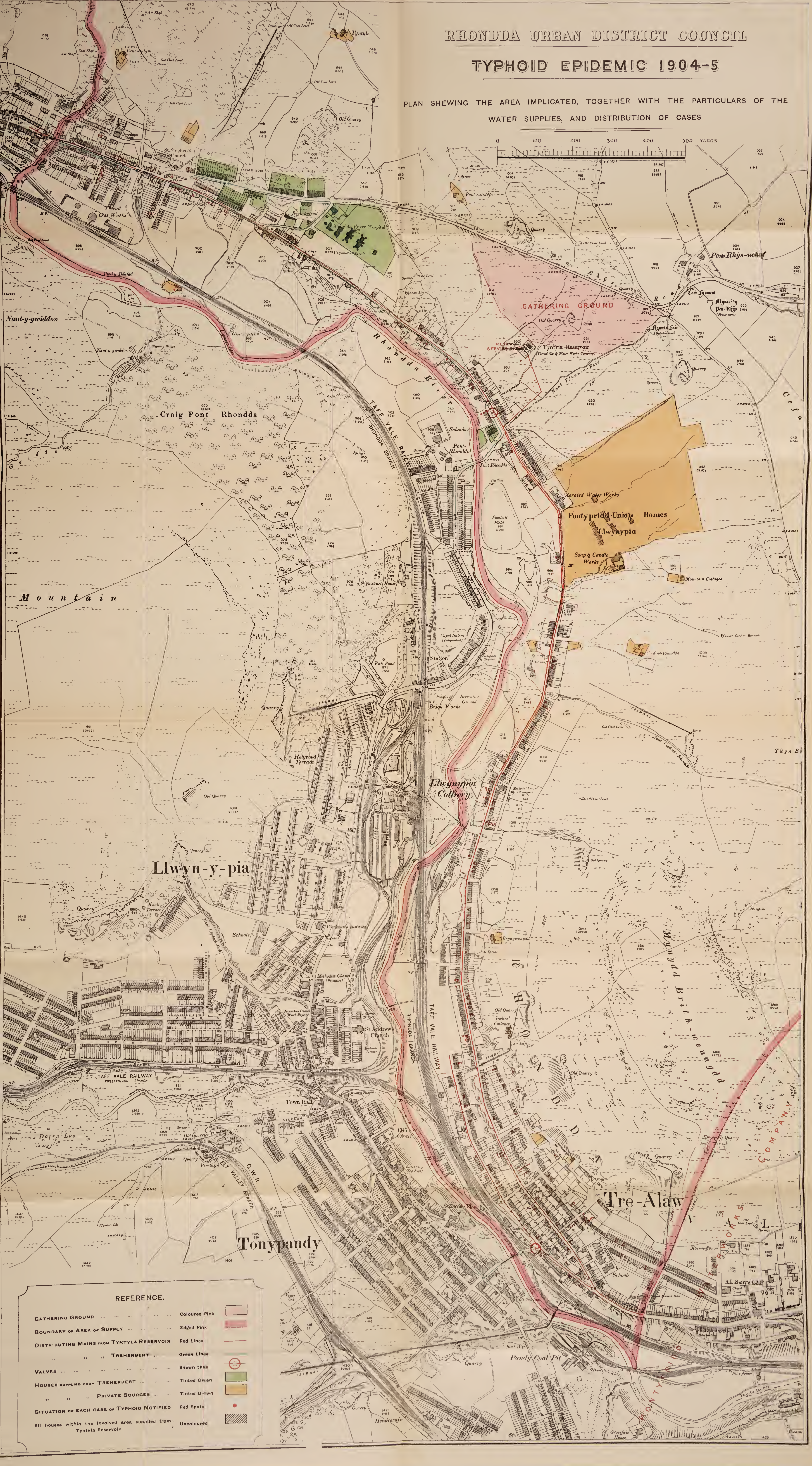
LOCAL INCIDENCE.

One of the most salient features in connection with the epidemic was the manner in which it confined itself to a comparatively small area placed in the centre of the larger of the two valleys of which the Rhondda Urban District is constituted. To illustrate this feature, two maps have been prepared, the one on the smaller scale opposite page 21 has been designed to show the relative extents of the implicated and the non-implicated areas. The whole district is divided on this map into two main portions ; the one consisting of the parts coloured blue and red denotes the Council's water area ; the other uncoloured represents the water area of the Pontypridd Waterworks Company. The comparatively small part coloured red is that which at the time of the epidemic was mainly dependent upon its supply upon the Tyntyla gathering ground, and was the area to which the epidemic was practically limited. The other map opposite page 32 is meant to represent, on a larger scale, the area of the epidemic. Its boundary is indicated by a pink edge for the greater part of its extent, the portion not shown limiting the hilly and unimportant side. The gathering ground is shaded red, and the water-main which served for the distribution of the Tyntyla water is indicated by a red line along the main road. The areas coloured green on the map represent the houses which were supplied, by means of the main also coloured green, with water from the Council's Works at Treherbert ; the same main is shown until it reaches a point some distance on the other side of the river and outside the epidemic area. The premises deriving their water from private sources

RHONDDA URBAN DISTRICT COUNCIL

TYPHOID EPIDEMIC 1904-5

PLAN SHEWING THE AREA IMPLICATED, TOGETHER WITH THE PARTICULARS OF THE WATER SUPPLIES, AND DISTRIBUTION OF CASES



REFERENCE.

Gathering Ground	Coloured Pink	
Boundary of Area of Supply	Edged Pink	
Distributing Mains from Tyntyla Reservoir	Red Lines	
" " " Treherbert	Green Lines	
Valves	Shewn thus	⊕
Houses supplied from Treherbert	Tinted Green	🟩
" " " Private Sources	Tinted Brown	🟫
Situation of each case of Typhoid Notified	Red Spots	●
All houses within the involved area supplied from Tyntyla Reservoir	Uncoloured	▨

mainly in the form of springs, are tinted brown. The shaded but uncoloured premises within the boundaries of the affected area are supplied with water from the Tyntyla Works. Each notified case of typhoid fever is represented by a red spot, the position of which in each instance indicates the house where such case occurred. A consideration of the distribution of the spots serves to demonstrate the great uniformity which marked the occurrence of the cases, and a comparison of the relatively small groups of houses which were left unaffected within the implicated area, with the much larger groups, also unaffected outside that area, furnishes a striking contrast. The statistics referring to the inequality of the distribution within the respective areas are given in a summarized form in Tables 3 and 8. The percentage incidence upon houses within the Tyntyla area of supply amounted to 20·2, whereas the proportion of the number attacked throughout the rest of the district amounted to ·11 per cent. of the total, (Table 3). If the rest of the district be further sub-divided in accordance with the different water supplies, the contrast is no less striking. Excluding that part of the Council's water area, which derives its supply from the Tyntyla gathering ground, the percentage incidence upon houses is only ·18 in that area, while in the Pontypridd Company's district the percentage incidence was ·03 (Table 8). The difference would be still more pronounced if the houses whose attacked inmates were ascertained on inquiry to have contracted the disease within the implicated area were excluded.

TABLE 8.—Showing the incidence of Typhoid Fever within and without the area of Epidemic.

DISTRICTS	Area of Epidemic			Rest of Council's water area			Independent Supplies within rest of Council's area and without area of Epidemic			Pontypridd Co.'s water area		
	Total	Number Attacked	Per cent	Total	Number Attacked	Per cent.	Total	Number Attacked	Per cent.	Total	Number Attacked	Per cent.
Houses	1,320	267	20 2	8,507	16	·18	1,600	3	·18	9,334	3	03
Persons	7,605	373	4 9	50,361	16	·03	9,472	5	·05	55,257	5	·009

TIME INCIDENCE.

In the course of the systematic investigation carried out in connection with each case notified, it was noticed that a great many of the earlier cases gave October the 29th as the day on which they first fell ill. If twelve days be allowed for the incubation period of typhoid fever, the date on which the water may have become contaminated falls on the 17th of October; the first notification was received on the 8th of November. The suspected water was cut off on the 9th of November, but the number of notifications continued to increase, until a climax was reached on the 15th, on which day 71 cases were notified. Subsequent to that date the rate at which the cases were reported rapidly diminished, so that during the second week after the water was turned off the total numbered 91 as compared with 197 in the previous week; in the following weeks the numbers further dropped to 23, 12, 4, and 3 respectively. If it be assumed that the incubation period lasts 12 days, and that an average period of 11 more days intervened between the onset and the date of notification, one would expect to find a retardation in the daily number of notifications received about the 2nd of December. Although such a check is noticeable, it is doubtful whether it can be said that the diminution was the direct result of the change in the water supply, for the infective material, from whatever source, may have become exhausted. As however it was not known, nor is it still known, whether the source of infection was such as to be capable of continuously acting for some time, the cutting off of the water may have served to obviate the occurrence of many more cases, and the consequent prolongation of the epidemic. The disinfection of the water mains was commenced on the 27th and completed on the 29th of November. Although it was shown by analysis and otherwise that the disinfection of the distributing mains was efficiently performed, a consideration of the time incidence of the cases subsequently notified does not satisfactorily prove that the disinfection had any marked influence in checking the spread of the disease; nevertheless it served to restore public confidence.

SECONDARY CASES.

Secondary cases may be taken to mean in this instance all those which occurred in previously infected houses after the first day or two in December, the suspected water having been cut off on the 9th of November. Prior to the 3rd of December 330 cases had been notified, of which 249, or 75 per cent., occurred in houses not previously implicated; subsequent to that date, and up to the end of the epidemic on February the 10th, 43 cases were notified, of which only 18, or 41·8 per cent., were primary or occurred in houses not known to be previously implicated. There is reason for believing that a number of the 18 cases just mentioned as having occurred in houses not already involved was after all secondary to cases whose attacks were of such a mild character that the nature of the disease was not recognized. The remainder of the 48 cases could very easily have been caused under the close association which necessarily existed between them and the primary cases under the conditions which obtained in the vast majority of the attacked houses.

THE RELATION OF THE EPIDEMIC TO THE RAINFALL.

According to the records taken by means of a rain gauge situated 400 yards from the gathering ground, the rainfall for the whole of October amounted to 3·21 inches, of which 2·36 occurred before the 14th of the month. The rest of the month was rainless with the exception of four days, ·12 inch falling on the 16th, ·50 on the 17th, ·20 on the 21st, and ·03 on the 26th. (See Appendix.) If the opinion previously expressed that 12 days prior to the 29th of October, in other words the 17th of that month, indicated more or less approximately the date on which the infective material reached the consumers, the view may be advanced that the half-inch rainfall which occurred on the 17th may have served as an adjuvant in the causation of the epidemic. The gathering ground and waterworks being only about 130 yards from the nearest houses supplied, the time intervening between the collection and the distribution of the water would be of very short duration. If however 14 days be taken as the more probable incubation period of typhoid fever, the date of contamination of the water supply would in consequence be thrown back to the 15th of October, which together with the preceding day was rainless.

MORTALITY FROM DIARRHŒA WITHIN AND WITHOUT THE EPIDEMIC AREA

If the death returns may be taken as an accurate measure of the extent to which diarrhœa prevailed within the district, it may be stated that during the summer immediately preceding the epidemic, this disease existed to an unusual degree within the area to which the typhoid outbreak was practically limited. Table 9 serves to emphasize the fact that for the 7 years 1899-1905, the mortality from diarrhœa in the year 1904 within the area of the epidemic, in relation to the rest of the district, was considerably higher than the average for those years. It may be added that all the deaths from diarrhœa within the typhoid-affected area occurred between August the 4th and September the 27th. Apart from these figures there is however no definite evidence obtainable that diarrhœa did actually exist to an abnormal extent, either at the time of or immediately preceding the epidemic in Ystrad and Trealaw. An analysis of the figures relating to typhoid fever itself also indicates the absence of any abnormal prevalence of that disease throughout the district, for up to the commencement of the epidemic the not excessive number of 110 notifications had been received in the course of the year. It is true that 46 of those came to hand subsequent to the first of August and prior to the 8th of November, but only 11 of the 46 were received throughout October and the first week in November, i.e. within five weeks of the day on which the first batch of notifications was received.

TABLE 9.—Diarrhœa within and without the epidemic area.

YEAR	Number of deaths within epidemic area	Number of deaths in rest of district	Percentage ratio of mortality from diarrhœa.	Percentage ratio of population
1899	13	169	7·6	6·6
1900	9	147	6·1	6·6
1901	16	324	4·9	6·6
1902	5	108	4·6	6.6
1903	5	104	4·8	6·6
1904	15	196	7·6	6·6
1905	4	166	2·4	6·6
Average	9	173	5·4	6·6

POSSIBILITY OF POLLUTION OF THE TYNTYLA WATER SUPPLY.

Previous to the occurrence of the epidemic there had been no exceptional prevalence of typhoid fever within the area as compared with the rest of the district. If the period intervening between the 31st of May and the 1st of November be taken, the fact is disclosed that, in proportion to the population, the incidence of the disease did not fall unduly heavily upon Ystrad and Trealaw, for throughout that period 76 notifications of typhoid fever were received from the whole district, of which only 4 were contributed by those localities. Two of the 4 cases were notified during October—one on the 3rd and the other on the 20th. The former was removed to the hospital on October the 3rd from an isolated cottage on the hillside about half a mile below the gathering ground, and was not discharged, after recovery, until November the 16th. The latter case was treated at home, which was situated 800 yards from the nearest point of the gathering ground, and had not sufficiently recovered for the disinfection of the premises to be effected until December the 3rd; the onset of the illness in this case is stated to have taken place on the 15th of October. There was no evidence available that either of these two cases could have been in any way instrumental, directly or indirectly, in causing the epidemic. The close proximity of the isolation hospital to the gathering ground, the distance between the two being only 230 yards, naturally aroused the suspicion that the typhoid cases treated at the hospital may possibly have been in some way concerned with the occurrence of the epidemic. It is practically certain, however, that the administration of the hospital is such as to render it impossible for any patient to have had any direct connection with the causation of the epidemic, for no patient after admission is allowed to leave the hospital grounds under any circumstances until the day of discharge. It may be added that the institution is surrounded by a stone wall 6 feet 6 inches high, and it would, for that and other reasons, be impracticable for any inmate to make a surreptitious excursion without the knowledge of the staff. The close relation of the watermain to the hospital drain just before the latter's entrance into the sewer in the main road, 60 yards from the hospital grounds suggested a possible source of contamination of the water supply, for the drain in its course to reach the sewer passes underneath the 6-inch water main which supplies the whole of the implicated area. At the instance of the Medical Officer of Health, Mr. W. J. Jones, the Council's Surveyor, exposed both the drain and water main at the point of crossing, and it was made apparent that no contamination could have taken place in this situation for all the joints were watertight, and the surrounding subsoil was dry and free from any trace of pollution. Similar steps were taken with a like result at another situation, where a certain house-drain was known to be exceptionally close to the water main for some distance.

As previously stated, there is no house or structure of of any kind upon the gathering ground, but as may be seen by reference to the reproduction of the photograph opposite page 28, the surroundings of the 18 odd acres which constitute this area, make it obvious that pollution of any point upon it is not an impossible event. There is evidence that the copses of wood mentioned as existing on the gathering ground, were occasionally resorted to on holidays and at other times by parties of pleasure seekers, contamination by one or more of whom may have taken place and easily escaped detection. The member of the Water Department who was in charge of the waterworks and who periodically inspected the gathering ground, was the object of an inquiry which included the submission of his blood to Widal's test by Drs. Williams and Schölberg at the County Laboratory. The result of the reaction indicated that the man had not recently suffered from any form of typhoid fever, and his statement that he had not had any kind of illness for some time was in support of the evidence afforded by the application of Widal's reaction.

CHEMICAL AND BACTERIOLOGICAL EVIDENCE.

Although the circumstances associated with the epidemic were such as to justify the suspicion that it had been caused and propagated by means of the Tyntyla water supply, the presence in the water of the specific organism which is accepted as the essential cause of typhoid fever was not proved. Altogether 5 samples were collected and sent to the County Laboratory for the purpose of being examined by Dr. H. A. Schölberg, the County Bacteriologist. Three of the samples were taken on the second day of the epidemic (November 9th); one of these was unfiltered water as it entered the settling tank; the second was derived from the surfaces of the screens, through which the water had to pass on its way to the filter-beds; and the third was got from the water in the settling tank just before its entrance to the filter-beds. On November 11th, two more samples were taken and similarly dealt with, one from a dead end on the water main situated at a low-lying position in the infected district; the other was taken by means of a sterilized spoon from twelve different points of the surface of the two filter-beds at the Tyntyla works Neither of the filter-beds had been scraped or cleaned for 44 days. On November the 14th also, a sample of human excrement situated within a few yards of one of the catch-pits on the gathering ground was taken by Drs. Williams and Schölberg on the occasion of their visit. By means of the processes usually adopted by the present-day bacteriologist, about 30 organisms were isolated and standard cultures made for the purpose of proving or disproving their identity with the specific typhoid organism. After a long investigation Dr.

H. A. Schölberg reported on December 13th that "In all cases the organisms failed in one or other point to fulfil the standard reactions of the typhoid bacillus."......"Speaking generally to the waters I may say that they contain a very high percentage of Coli-like organisms." (See Appendix). A sample of water was taken on November the 16th for the purpose of submitting it to chemical analysis by Mr J. H. Sugden, of the County Laboratory, who reported that "The physical appearance and the suspended matter are unsatisfactory. The analysis shows evidence of some surface contamination." There had been no measureable rainfall during the time intervening between the 11th and the 17th of November, the dates on which samples were taken for bacteriological examination and chemical analysis respectively.

OTHER POSSIBLE CAUSATIVE AGENTS.

The accumulated experience of other Authorities, as well the very recent experience of the Rhondda Sanitary Authority, safeguarded the latter from ignoring the possibility of other factors entering into the causation of the epidemic. All articles of food and drink received some attention in the course of the inquiry, but after a due consideration of the evidence available, one was led to the conclusion that, with the single exception of water, no one factor or combination of factors could satisfactorily account for the character of the outbreak, the general distribution of the disease within well-defined limits, its selection of houses on Tyntyla water, and its avoidance of houses on other supplies. Milk naturally demanded careful consideration, and for a few hours after the commencement of the epidemic, that vended by a certain milkman was suspected of being the vehicle instrumental in causing the spread of the disease. Later events, however, served to remove the suspicion which for a brief period rested on that particular supply, and provided satisfactory evidence that milk, from whatever source, was innocent of any direct influence in the causation of the outbreak. The invaded households, taken collectively, bought milk from no fewer than twenty-one dairymen, while a few consumed none but condensed milk. As a great many of the dairies were situated in the implicated area, and received their water from the Tyntyla tank, much anxious thought was given to the problem as to how best to prevent the various milk-supplies from serving as secondary means of propagating the disease; and in no connection were the services of Inspectors J. Towy Thomas and James Williams of greater importance than in their unremitting and successful endeavours to deprive the many milk supplies of their great potentiality to prolong, and to extend the range of, the epidemic.

The performance of the many duties devolving upon those immediately concerned with the prevention of the spread of the disease was much facilitated by the assistance readily given by Mr. Rhys S. Griffiths, as Chairman of the Special Committee appointed by the Council; by Mr. Octavius Thomas, Gas and Water Manager, in connection with the disinfection of the mains and the supply of much information relating to the Tyntyla supply; by Mr. W. J. Jones, the Council's Engineer and Surveyor, as well as Messrs. Read and Thackeray, his assistants, especially in the preparation of the maps in this report; by Dr. W. E. Thomas and his assistant, Dr. E. L. Phillips, as well as by Dr. Washington David and his assistants, Drs. Alfred Jones, John David, and Idris Morgan, in the supply of much information over and above that required by the Infectious Disease (Notification) Act; by Dr. W. Williams, the County Medical Officer, and his staff, in the provision of valuable advice, and in the prompt prosecution of the investigations relating to the examination of the samples of water taken; by temporary Inspector Gwilym Griffiths, especially in connection with the preparation of the "spot map" embodied in this report; and, not least of all, by Miss Smith, the Matron of the Hospital, and her staff, in the devoted manner in which they performed duties of an exceptionally arduous and trying nature.

APPENDIX.

The Cardiff and County Public Health Laboratory,
9, The Parade,
CARDIFF,

December 13, 1904.

Interim Report on Samples of Water sent by the Medical Officer of Health to the Rhondda Urban District Council in connection with an outbreak of Typhoid Fever in November, 1904.

Five Samples of water were received, labelled as follows:—

(1) On November 9th, 1904. *Unfiltered Water* from the Tyntyla Reservoir.

(2) On November 9th, 1904. Scrapings from the screens where the water flows in from the pipe collecting the water from the gathering ground.

(3) On November 9th, 1904. Further Scrapings from the surface of the storage tank after the water has been screened.

(4) November 11th, 1904. Water from a "dead end" near Ystrad Gas Works, which are in the stricken district.

(5) November 11th, 1904. Sample from infected area. Scrapings from film on surfaces of two filter beds through which the suspected water must have passed. These beds have not been cleaned for one month.

Sample (1). Examined the same day as collected.

Unfiltered Water:

Quantitative—

Number of organisms per cubic centimetre developing at 37° C. taking $\frac{1}{10}$ c.c.	2080 per c.c

Qualitative—

B. Coli present in $\frac{1}{10}$ c.c., $\frac{1}{2}$ c.c. 2·0 c.c. and 10.0 c.c.

Sample (2). This and succeeding samples were examined qualitatively only, and that for the specific cause of Typhoid Fever, viz., the Typhoid Bacilli. As will be seen, all the samples except *No 4* will of necessity have a high bacterial content per cubic centimetre, but of the organisms met with, those only were subcultured that at first sight, when growing on a selective medium, showed any resemblance to the B. Typhosus.

To avoid repetition, I will deal with all the samples at once, seeing that all were treated in exactly the same way.

Samples (2, 3, 4 and 5) were subcultured from their corresponding Agar Fuchsin surface plates with Litmus Lactose Peptone: all the cultures that produced no change in this medium were further subcultured. In this way some 30 organisms were isolated, and standard cultures made so as to identify or reject them from being the Typhoid organism.

In all cases the organisms failed in one or other point to fulfil the standard reactions of the Typhoid bacillus. I may say that some of these reactions take a fortnight or more to be completed; for example, the liquefaction of gelatine which has taken place in those which at first gave hope of their being the Typhoid bacillus..

Speaking generally with regard to the water, I may say that they contain a very high percentage of Coli-like organisms, and even the unfiltered water is bacteriologically unsatisfactory as a source of supply under the circumstances that obtain, and yield so high a bacterial content per cubic centimetre.

H. A. SCHÖLBERG.

Dec. 5th, 1904.

Report on Analysis of Sample of Chlorinated Lime Solution received on Nov. 28th. 1904. from Dr. J. D. Jenkins, labelled Tap, Tyntyla Road, after standing 3 hours. Available Chlorine = ·55 per cent.

Germicidal Power.

The following dilutions were made :—

A 5 c.c. diluted to 10 c.c. with broth = $\frac{1}{2}$ strength
B 2 c.c. ,, ,, ,, $\frac{1}{5}$,,
C $\frac{1}{2}$ c.c. ,, ,, ,, $\frac{1}{20}$,,
D $\frac{1}{10}$ c.c. ,, ,, ,, $\frac{1}{100}$,,

Each was inoculated with a loopful of 24 hours broth culture of Bacillus Typhosus, and allowed to stand 3 hours.

A and B—Sterile.

C and D—Growth of Bacilli, resembling Bacillus Typhosus.

REMARKS.—The examination shows a solution of one-fifth the original strength of chlorinated lime, capable of destroying fresh Typhoid Bacilli in three hours.

Signed J. H. SUGDEN.
W. WILLIAMS.

Report on Analysis of Samples of Tyntyla Water received on Nov. 28th from Dr. J. D. Jenkins.

Labelled—(a) Service Tank. 2-0 p.m., 27/11/04.
After mixing chlorinated lime solution.
(b) Tap, Tyntyla Road.
After standing in service pipes for 3 hours.
11-0 a.m. to 2-0 p.m., 27/11/04.
(c) Tap, No. 10 Gelligaled Road, Ystrad.
After flushing of mains. Nov. 28th, about 12·0 noon.

The samples were found to contain the following amounts of available Chlorine :—

(a) ... ... ·53 per cent
(b) ... ... ·55 ,,
(c) ... ... Nil

REMARKS.—The sample taken after three hours action shows no decrease in amount of available Chlorine.

Signed J. H. SUGDEN.
W. WILLIAMS.

Report on Analysis of Sample of Water, Received on Nov. 16th, from Dr. J. D. Jenkins, labelled Tyntyla Bye-pass from pipe which fills Filter-Beds.

Number of Sample		217
Date of Analysis		November 17th and 18th.
Appearance in two-foot tube		Yellowish-green. Distinctly turbid.
Reaction		Faintly alkaline.
Total solid matter	parts per hundred thousand	—
a. Volatile		—
b. Fixed		—
Appearance on Ignition		Small Blackening.
Total Hardness...		6·2^0 H
a. Temporary		—
b. Permanent		—
Chlorine		1·05
Nitrogen as Nitrates		Very faint traces.
Oxygen absorbed from Permanganate		—
Saline (or " Free ") Ammonia		·0016
Organic (or " Albuminoid ") Ammonia		·0044
Poisonous Metals		Nil.
Nitrites ...		Nil.
Phosphates		No appreciable trace.
Sulphates		Small amount.
Microscopic Examination of the Sediment ...		Considerable amount. Sand. Vegetable debris, pitted and spiral vessels. Various animate forms Fungi.

Remarks :—

A fairly soft water.

Physical appearance and the suspended matter are unsatisfactory.

The analysis shows evidence of some surface contamination.

Dated Nov. 18th, 1904 J. H. SUGDEN.

Rhondda Urban District Rainfall in 1904.

(Gauge within area of Epidemic and about 350 yards
from Tyntyla gathering ground.)

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	—	·40	—	·02	·79	—	·40	—	—	—	—	·42
2	.20	—	·10	·20	·20	—	·60	·22	·92	—	—	·83
3	·40	—	—	.37	—	—	·01	·50	—	—	—	·42
4	·28	·20	·22	1·00	·03	—	·05	—	—	·60	·02	1.04
5	—	·42	·20	·78	·04	—	—	—	·12	—	·10	1·03
6	·50	·06	—	—	·52	—	—	—	·27	·21	·21	·22
7	1·58	·61	74	·03	—	—	—	—	·46	1·24	1·43	·02
8	—	1.00	·04	·04	·12	—	—	—	·20	—	·87	·30
9	·30	—	—	·10	·12	—	—	·10	·19	—	·97	·44
10	·38	·68	·13	—	—	—	—	·30	·46	·04	·86	·50
11	·64	1·00	—	—	—	—	—	—	·18	·06	—	·20
12	1·38	1·38	—	·35	—	—	—	·06	·44	·07	—	·05
13	·20	·37	—	·42	—	·34	·24	·35	·42	·14	—	-
14	·50	·40	—	·06	—	1·00	—	·52	·22	—	—	—
15	·03	·11	—	—	—	—	—	—	—	—	—	·13
16	·05	·04	—	—	—	·37	—	·20	—	·12	—	·02
17	·02	·12	—	—	—	·10	—	·40	—	·50	—	·34
18	·07	·03	·05	—	—	—	·42	—	—	—	—	·40
19	—	·72	·20	—	—	—	—	—	—	—	·05	·30
20	·02	·10	—	—	—	—	—	·13	—	—	—	—
21	—	·30	·24	·09	·11	—	·05	1·27	—	·20	·32	—
22	—	·05	—	·25	—	—	1·00	·15	—	—	·13	—
23	—	·01	·05	—	1·54	—	·70	·80	—	—	·04	—
24	—	—	—	—	·66	·22	·06	·03	—	—	—	—
25	·05	—	—	—	—	—	1·15	—	—	—	—	·14
26	2·00	·63	·11	—	.35	—	—	—	·22	·03	—	—
27	·86	·01	—	·04	·13	—	—	—	—	—	—	—
28	·30	—	1'00	'15	—	—	·30	—	—	—	·03	·10
29	·74	—	·20	·30	—	—	·30	·07	—	—	·22	·08
30	·37		—	·52	·06	·22	—	·13	1·00	—	·02	·11
31	·20		·24		·03		—	.20		—		—
Tot'ls	11·07	8·64	3·52	4·72	4·70	2·25	5·28	5·43	5·10	3·21	5·27	7·09

Total fall for the year 66·24